

Seasonal Variations in Vertical Profiles of Carbonyl Sulfide, Halocarbons, and Benzene over North America

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A NOAA sampling program to measure vertical profiles of CO₂, CH₄, N₂O, and other gases within the lower atmosphere has been expanded to allow measurements of carbonyl sulfide (COS), CFCs, HCFCs, HFCs, chlorocarbons, bromocarbons, methyl halides, and benzene. Bimonthly to monthly profiles for these gases have been obtained since September 2004 from flasks collected onboard aircraft at altitudes up to 8 km above sea level at multiple continental and coastal sites in North America. The wide range of gases being measured aid in identifying many different influences on sampled air, such as combustion, input from the oceans, urban emissions, non-urban terrestrial emissions, uptake by vegetation and soils, and vertical mixing. Based upon co-elevated mixing ratios of halocarbons and carbon monoxide or halocarbons and C₂Cl₄, we anticipate that this sampling program has the potential to provide continental-scale emissions estimates for non-CO₂ gases that are currently regulated, for example by the Clean Air Act and the Montreal Protocol of Substance that Deplete the Ozone Layer, and for gases listed in the Kyoto Protocol that may be regulated in the future.

In addition to the observation of urban pollution and burning plumes, strong and persistent vertical gradients have been observed that vary with season for COS, methyl halides, and chloroform as presented in Figure 1. The results for COS are particularly dramatic, as they show substantially reduced mixing ratios in the continental boundary layer during the growing season. The spatial patterns and seasonality are qualitatively consistent with uptake of COS by photosynthetically active vegetation.

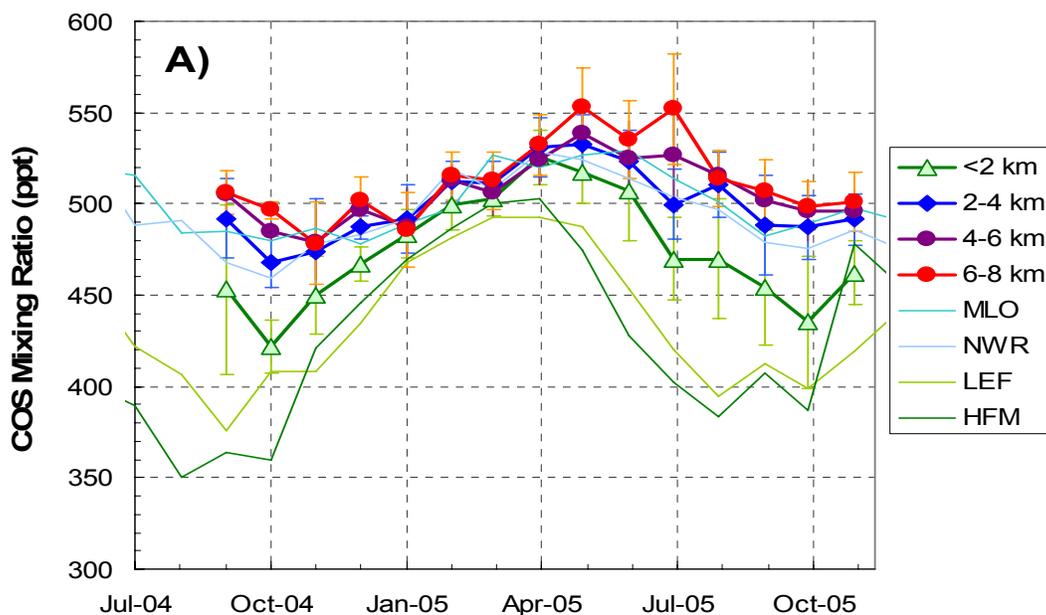


Figure 1. Mixing ratios of carbonyl sulfide from aircraft samples collected over the continental US (binned by month and sampling altitude) compared to results from NOAA surface sites MLO (Hawaii), NWR (Colorado), LEF (Wisconsin), and HFM (Massachusetts). Large gradients are observed at the surface sites and vertically above the continent from April-May through October-November.